TREX MID-INFRARED SPECTRA OF FINE-PARTICULATE MINERALS FOR APPLICATION TO DUSTY AIRLESS BODIES.

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Introduction: Many of the surfaces of airless bodies in our solar system, to varying extent, are coated in fine dust due to long-term impact processing. In order to better interpret remote-sensing data from those bodies, our team is developing a robust spectral library of *fine particles* (<10 μm) that will include a wide variety of minerals, meteorites, and lunar samples.

Here we present our *mid-infrared* analyses of fine-particle minerals acquired at 80 ºC (ambient P), 150 ºC (vacuum), and 300 ºC (vacuum).

Mineral Samples: We currently are analyzing a suite of 28 terrestrial mineral samples (see Table 1 in [1], this meeting).

Laboratory Details and Measured Environments: For direct application to airless bodies, laboratory spectra must be obtained under vacuum conditions over a range of representative surface temperatures because atmospheric pressure and surface temperature affect spectral characteristics, especially for fine-particulate samples wherein thermal gradients are enhanced.

Surface temperatures on targets of interest for SSERVI crewed missions (Moon, Martian moons, asteroids) vary dramatically due to the lack of atmosphere and can reach up to 300 ºC, as expected for typical Near Earth Asteroids [2].

Mid-infrared (MIR) emissivity measurements were made at the Deutsches Zentrum für Luft- und Raumfahrt (DLR, Berlin, Germany), using 2 different spectrometers:

Spectrometer 1 -- For the induction-heated, 80 ºC, ambient P emissivity data (2000-500 cm^{-1}), a KBr beamsplitter and a cooled MCT detector were used.

Spectrometer 2 -- For the induction-heated, 150 and 300 ºC, vacuum P emissivity data (2000-624 cm^{-1}), a KBr beamsplitter and a cooled MCT detector were used.

Mid-infrared (MIR) Spectra: Coarse-sample MIR spectra typically are dominated by fundamental vibrational modes (some overtones). However, for fine-particulate, high-porosity samples, the fundamental bands (FB) shrink and the spectra exhibit volume-scattering, "transparency" features (TF) [3,4] (Fig. 1).

When a fine-particulate sample is measured at higher temperatures and vacuum conditions, the spectra vary further. Figure 1 is representative of the spectral data we acquired of our mineral samples.

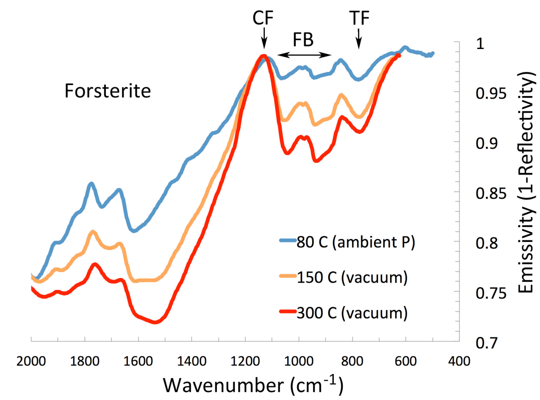

Figure 1. Spectra of fine-particulate forsterite olivine acquired at 80 ºC under ambient P (blue), at 150 ºC under vacuum P (orange), and at 300 ºC under vacuum P (red). Note: 1000 cm^{-1} is equivalent to 10 μm.

Effects of low-pressure (airless) and high-temperature environments. Under low atmospheric pressure conditions (minimal interstitial gas), fine particles on planetary surfaces are poor heat conductors and have an insulating effect, causing steep thermal gradients [5,6,7], effectively shifting the Christiansen Frequency (CF) to shorter wavelengths (higher wavenumbers) and deepening the FB overall, but decreasing the distinction of each individual band (Fig. 1). (Coarser particles are not affected to the same degree.) Our results are similar to those obtained by [7,8,9]. Due to the differences in spectra between those obtained under ambient conditions from those obtained under vacuum, typical 1-atm laboratory spectra are decreasingly useful for determining mineralogy on airless bodies, especially for fine-particulate surfaces.

Hence, the spectra from our study are important to have in a spectral library for studying airless bodies. Many more spectra will be presented at the meeting.

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